HOW MUCH OF THE PILON CAN YOU SEE FROM THE BACK? A CADAVERIC STUDY OF THREE SPECIFIC APPROACHES

INTRODUCTION

In a previous article ⁽¹⁾ we outlined the three common posterior approaches for reduction and fixation of pilon fractures. The objective of this study is to critically review the posterior anatomy in order to see how much of the posterior pilon we can see with each approach, and what structures are at potential for injury. The three exposures we will cover include the posteromedial approach, the posterolateral, and the modified posteromedial approach.

Posterior approaches were originally designed for fixation of the Volkmann fragment frequently occurring with a malleolar fracture, the so-called trimalleolar fracture. This "posterior pilon" fracture was originally described by Hansen ⁽²⁾. They have become more frequently utilized for exposure and fixation of the posterior component of a pilon fracture. In fact, the indication for first going posterior is to restore the posterior column of the distal tibia and plafond, correcting any shortening and malalignment, so the posterior column can serve as a template to reduce the anterior column ⁽³⁾. But through which posterior approach can we best see what needs to be corrected and stabilized?

The posteromedial approach is not commonly used for the typical pilon fracture. It occasionally can be of value when there is a large posterior fragment with an intact anterior pilon. Through this incision a posteromedial plate can be placed to buttress a posteromedial fragment, but does not allow for visualization and plate position more laterally. Moving to a posterolateral incision will help with posterior exposure more laterally but fails to show us the whole surface of the posterior plafond which may be necessary for open reduction and internal fixation. For more complex fractures involving medal and lateral parts of the pilon fracture a modified posteromedial approach ⁽⁴⁾ has been shown to provide a greater degree of

exposure. A recent article ⁽⁵⁾ pointed out the great variability of the posterior fragment in association with ankle fractures, and the same is true if not more so in attempting to understand the posterior fracture with pilon fractures. Computed tomography (CT) is mandatory to not only understand the morphology of the posterior fragment, but as well to define the most useful approach to these injuries.

MATERIALS AND METHODS

With the above points in mind, three posterior approaches - posteromedial, posterolateral, and modified posteromedial - were made on cadaveric specimens. We used nine specimens, fresh-frozen below the knee legs with three for each approach. The Dissection Room of the University of Barcelona, Campus Bellvitge (C/Feixa Llargas/n 08907, L'Hospitalet de Llobregat, Barcelona, Spain) provided all the cadaveric specimens. All limbs were carefully examined for signs of previous incisions or scars, and if any present, discarded. Three senior orthopaedic surgeons (RS, MA, AR) in agreement performed the three standard posterior approaches to the tibial pilon in the specimens. They applied what they considered "safe" distraction to visualize the posterior pilon as would be performed in the operating room. Potential anatomical risks and the amount of visualization of the tibial pilon were recorded.

In order to clearly illustrate the way-in of each approach, the results were translated to a transversal cut at the level of the tibial pilon. Three additional frozen specimens were utilized to perform the transversal cut with a diamond band saw (Exakt Advanced Technologies GmbH, Norderstedt, Germany) and apply the specific approach to it.

RESULTS

Figure 1 shows the standard exposure of the posteromedial pilon obtained by the posteromedial approach, which hinges on the tibialis posterior (TP) and flexor digitorum

longus (FDL) on the medial side, and the muscle belly of the flexor hallucis longus (FHL) laterally. Thus it provides excellent visualization of the medial two-thirds of the posterior pilon but cannot provide visualization and exposure of the lateral one-third, syndesmosis and fibula. One must avoid over-distraction laterally with resultant damage to neurovascular structures. Figure 2 shows the standard exposure of the posterolateral pilon, the syndesmosis and the fibula obtained by the posterolateral approach. This approach hinges on the peroneal tendons laterally, and the FHL muscle belly medially. It permits safe exposure of approximately one-half of the posterior pilon, but the Tendo Achilles (TA) and the FHL make it difficult to get more medial on the pilon. There are no neurovascular structures of concern as they are protected by the bulk of the FHL that always extends quite distal. Figure 3 shows the exposure of the posterior pilon obtained by the modified posteromedial approach which hinges on the TP and FDL medially and the FHL muscle belly and tendon laterally. It permits exposure of the entire posterior pilon, syndesmosis, and fibula. The neurovascular structures are medial and "safe" traction does not place them under undue tension. The TA and FHL are retracted laterally with little effort.

DISCUSSION

The sectional anatomy obtained in this study compares three possible approaches to the posterior pilon. The indication for each approach should be based upon fracture anatomy. Whether there is a "simple" isolated posteromedial or posterolateral fragment, or a more complex fracture of the back of the pilon, these three options show the way in and important structures to avoid.

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FIGURE LEGEND

Figure 1: Posteromedial approach: Yellow arrow = the way in for this surgical approach.

- 1) Tibialis posterior tendon.
- 2) Flexor digitorum longus tendon.
- 3) Posterior tibial artery and accompanying veins (digitally colored in red).
- 4) Tibial nerve (digitally colored in yellow).
- 5) Tendo Achilles
- 6) Flexor hallucis longus muscle belly and tendon.

Figure 2: Posterolateral approach: Yellow arrow = the way in for this surgical approach.

- 1) Tibialis posterior tendon.
- 2) Flexor digitorum longus tendon.
- 3) Posterior tibial artery and accompanying veins (digitally colored in red).
- 4) Tibial nerve (digitally colored in yellow).
- 5) Tendo Achilles.
- 6) Flexor hallucis longus muscle belly and tendon.
- 7) Muscle belly of flexor hallucis longus, cut to access posterolateral area of the pilon.
- 8) Peroneus brevis muscle belly and tendon.
- 9) Peroneus longus tendon.
- 10) Lesser saphenous vein.
- (11) Sural nerve.

Figure 3: Modified Posteromedial approach: Yellow arrow = the way in for this surgical approach.

1) Tibialis posterior tendon.

- 2) Flexor digitorum longus tendon.
- 3) Posterior tibial artery and accompanying veins (digitally colored in red).
- 4) Tibial nerve (digitally colored in yellow).
- 5) Flexor hallucis longus muscle belly and tendon.
- 6) Tendo Achilles.